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LARVAL FOODPLANT RECORDS FOR *PAPILIO ZELICAON* IN THE WESTERN UNITED STATES, AND FURTHER EVIDENCE FOR THE CONSPECIFICITY OF *P. ZELICAON* AND *P. GOTHICA*

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INTRODUCTION

Following the description of *Papilio gothica* Remington (1968), several authors have questioned the validity of this entity. Clarke and Sheppard (1970) discussed the ecologic and genetic evidence presented by Remington and concluded that *gothica* is best considered a minor high mountain ecotype of *P. zelicaon* Lucas. Shapiro (1975) discussed the phenotypic plasticity of *zelicaon* in light of an analysis of the frequency of *gothica* and *zelicaon* characters in spring and summer samples of lowland *zelicaon* in California. He concluded that the seasonal phenotypic change, characteristic of a number of western North American species, in which a vernal phenotype of a multivoltine lowland population resembles the high elevation univoltine phenotype of the same species, applies also to *P. zelicaon,* and that Remington's characters were of little value in distinguishing *P. gothica* from the spring brood of California *zelicaon.*

This paper summarizes our own field work with *P. zelicaon* over a ten-year period. During the summer of 1967, we made detailed field studies of *P. gothica* in the vicinity of Gothic, Gunnison County, Colorado, the type locality. The same year and in subsequent seasons, we were able to document a number of foodplants for widespread populations of *P. zelicaon,* as well

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as make observations on voltinism in these populations. Our data lend further support to the concept that *gothica* and *zelicaon* represent the same species, as will be discussed below.

The foodplant records are documented in the Appendix in accordance with a method that we have previously described and used (Shields et al, 1969), and are summarized in the Table.

FOODPLANTS OF *P. GOTHICA* IN THE TYPE LOCALITY

In the description of *gothica,* Remington noted that all wild larvae (a total of five) taken by him and his assistants were found on *Pseudocymopterus montanus* (A. Gray) Coulter & Rose (Apiaceae). A search of three other apiaceous plants, namely, *Ligusticum porteri* Coulter & Rose, *Oxypolis fendleri* (A. Gray) A. Heller, and *Heracleum lanatum* Michx. (= *H. sphondylium* L.), failed to reveal immatures. No mention is made of other apiaceous plants growing in the area. Remington concluded that "*Pseudocymopterus* is surely the preferred wild host of *gothica* in Colorado."

We observed a single oviposition on *Pseudocymopterus montanus* near Crested Butte (6 air miles from Gothic). Following this, we repeatedly searched *P. montanus* plants in the vicinity of Gothic over a two-month period, but failed to find any *Papilio* immatures on it. However, searches of certain other apiaceous plants in the area revealed good numbers of *gothica* larvae. We found a total of sixty larvae on *Angelica ampla* A. Nels., six larvae on *Conioselinum scopulorum* (A. Gray) Coulter & Rose, and one larva on *Heracleum sphondylium.* In addition, we observed one oviposition on *Ligusticum porteri.*

We believe *A. ampla* and *C. scopulorum* to be the principal foodplants of *P. gothica* in the type locality, with *P. montanus, H. sphondylium,* and *L. porteri* serving as only occasionally used hosts. We found larvae common on *A. ampla,* relative to the foodplant biomass available. This large (flowering stems up to 2 m. high) umbellifer grows in wet meadows, often near streams. Along the East River below Gothic, we found *Papilio* larvae on the leaves of this plant with relative ease. Some plants yielded up to five or six larvae. We had a similar experience with *C. scopulorum.* This is a smaller (1 to 3 dm. tall) plant which also grows in wet meadows. Although larvae are much more difficult to locate on this plant due to the multi-dissected leaves which create a disruptive mottled shadowing, we were able to find

six larvae in an area approximately 5 m. X 10 m. in 15 minutes. This contrasts sharply with the extensive time we spent searching plants of *P. montanus, L. porteri,* and *H. sphondylium,* only to note a single oviposition or larva on each of these. Furthermore, these latter three plants are common in the Gothic area, and present a larger biomass of potential foodplant than does either *A. ampla* or *C. scopulorum.* We found leaves of *A. ampla* and *C. scopulorum* both to possess a much stronger "parsley" odor when crushed than did leaves of *P. montanus, L. porteri,* and *H. sphondylium.* Perhaps ovipositing females are responding to this stronger olfactory stimulus, if human olfactory assessment is any measure of biochemicals important to the butterfly.

Remington also concluded that *gothica* prefers to oviposit on the flowerheads of the foodplant, while lowland *zelicaon* in California oviposits on both flowers and foliage, perhaps preferring the leaves. This was offered as an additional biological difference between *gothica* and *zelicaon.* However, all of the larvae we found on *A. ampla* were on the leaves of the plant, and most of these plants had no flowerstalks. The single ovipositions we observed on *P. montanus* and *L. porteri* were both on leaves, and the single first-instar larva taken on *H. sphondylium* was on a leaf of a non-flowering plant. Thus it appears that *gothica* may oviposit on either flowerheads or leaves, with an apparent preference for leaves.

RELATIONSHIP OF FOODPLANTS TO VOLTINISM OF *P. ZELICAON* POPULATIONS

The univoltinism of *P. gothica* was cited by Remington as another biological character distinguishing it from the multivoltine, lowland *P. zelicaon* of California. From our observations on California *zelicaon,* it appears that multivoltinism is primarily a characteristic of populations which feed on either the introduced *Foeniculum vulgare* L. (Apiaceae) or *Citrus* species (Rutaceae). *F. vulgare* provides some green foliage, flowers, or green seeds virtually twelve months of the year in most lowland areas. It often grows in vacant lots which are frequently cultivated in early summer for weed or fire control. The deep taproots of this perennial, unaffected by this superficial cultivation, sprout new foliage which is then utilized by later broods of *zelicaon* through the summer and fall months. *Citrus,* an evergreen subtropical tree, is available the entire year and *zelicaon* popula-

tions utilizing it are multiple-brooded (J. F. Emmel, unpublished data).

For low or mid-elevation populations on certain native apiaceous plants which remain green and succulent for four or five months, such as *Tauschia parishii* (C. & R.) Macbr., *Oenanthe sarmentosa* Presl., or *H. sphondylium*, there is a small percentage of pupae which do not diapause and emerge as a second brood. However, in other areas of lowland California, the native umbellifers used by *P. zelicaon* remain green just long enough to support a single generation of larvae. Examples of this type of foodplant are *Lomatium dasycarpum* (T. & G.) Math. & Const., *L. californicum* (Nutt.) M. & C., *L. marginatum* (Benth.) C. & R., and *L. utriculatum* (Nutt.) C. & R. in the North Coast Ranges and Sierra Nevada foothills. All of the pupae reared from larvae that we found on these *Lomatium* species went into diapause. Although the numbers we reared are too small to be statistically significant, it is not unreasonable to assume that at least some of these low-elevation, *Lomatium*-feeding populations are univoltine. By the time a second brood would be emerging, nearly all available foodplants would be turning brown and dying back, a distinct selective *dis*advantage for non-diapausing individuals. Thus in terms of voltinism, many lowland California populations of *P. zelicaon* probably do not differ from *P. gothica*.

Because Remington distinguished *gothica* from nominate *zelicaon*, it is of interest to speculate as to whether the type specimen of *P. zelicaon* was taken from a univoltine or multivoltine population; the type locality is merely given as "California" (Lucas, 1852). Remington apparently assumed that multivoltine *zelicaon* was nominate, but his basis for this assumption is not documented. At the time the type was collected (ca. 1850), the extent of introduced *Foeniculum vulgare* may have been very small indeed, and *Citrus* was not being grown on a large scale. The type, even if taken from a lowland area, could have been from a univoltine population. The development of the multivoltine, *Foeniculum*-feeding and *Citrus*-feeding ecotypes probably took place toward the end of the 19th century as these two foodplants became increasingly abundant. Obviously, much more field work and historical research needs to be done to determine more precisely the interrelationships of voltinism and foodplant usage in California populations of *P.*

zelicaon, as they exist now and as they were at the time *zelicaon* was named.

SUMMARY

1. Twenty-seven larval foodplants, in the families Apiaceae and Rutaceae, are documented for various populations of *Papilio zelicaon* in the western United States.
2. Field observations in the type locality of *Papilio gothica* indicate that at least five native foodplants are used, contrary to the statement in the original description of this butterfly that the sole foodplant is *Pseudocymopterus montanus*.
3. At low elevations in California, voltinism of *P. zelicaon* seems to be dependent on the nature of the foodplant(s) used by a given population. Many lowland populations are apparently univoltine due to the unavailability of green foodplant for a second generation, in spite of a long climatically favorable season. However, lowland populations utilizing certain other native foodplants with long-lived green leaves, or the introduced *Foeniculum vulgare* or *Citrus* species, are multivoltine.
4. These observations are interpreted as giving further support to the concept that *P. zelicaon* and *P. gothica* are conspecific, and that *P. gothica* is at best an ecotype of *P. zelicaon*.

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APPENDIX

Foodplant Records for *P. zelicaon*

As we consider *zelicaon* and *gothica* to be conspecific, no distinction is made between these two in listing the records. All foodplants are in the family Apiaceae (= Umbelliferae) unless otherwise noted. Abbreviations used for herbaria where voucher plant specimens are deposited are as follows: CAS, California Academy of Sciences, San Francisco; DHSU, Dudley Herbarium, Stanford University, California; RMBL, Rocky Mountain Biological Laboratory herbarium, Gothic, Gunnison Co., Colorado; RSABG, Rancho Santa Ana Botanic Garden herbarium, Claremont, California; UCB, University of California at Berkeley. Most plant determinations were confirmed by the following botanists: Nos. 1, 10, 13, and 22 by Mildred Mathias, University of California at Los Angeles; Nos. 2, 4, 5, 8, 11, 12, 14-21, 24-26, and 28 by Dennis Breedlove, CAS, and Lincoln Constance, UCB; Nos. 3, 6, 7, 27, and 29 by Richard Tilforth and Robert Thorne, RSABG. All specimens of *P. zelicaon* adults or immatures are deposited in the collection of the Los Angeles County Museum of Natural History. All observations of oviposition or collection of immatures were made by J. F. Emmel and O. Shields unless otherwise noted. Plant records are listed in alphabetical order to facilitate cross-reference with the listing in the table.

1. COLORADO: Gunnison Co.; near Brush Creek Cow Camp, along the East River below Gothic, 9000'; VII-24-67, 40 1st-3rd instar larvae taken on leaf uppersides of *Angelica ampla* A. Nels.; VIII-27-67, 20 4th-5th instar larvae taken on leaf uppersides of same plant species; approximately 20 larvae reared to pupae on leaves of this plant, all emerging in the spring of 1968. Plant material was collected (but not pressed) and found to be identical with a specimen of *A. ampla* in the RMBL herbarium, *D. Dunn 14,625,* collected along the East River below Gothic. Our plants also keyed out to *A. ampla* in Harrington (1954). This foodplant is somewhat local along the East River below Gothic, but immatures are easily located on the upper surfaces of the large, pinnately-dissected leaves. Some plants yielded up to six larvae. The majority of larvae were found on non-flowering plants.

2. CALIFORNIA: Siskiyou Co.; Caribou Lake, 6900', Trinity Alps; VII-22-68, 4 3rd-5th instar larvae taken on leaf uppersides of *Angelica arguta* Nutt. ex. T. & G., *J. F. Emmel 90,* UCB; larvae not reared. This plant is widespread in the mountains of northwestern California, and probably repre-

sents one of the major foodplants of *P. zelicaon* in this region.

3. CALIFORNIA: San Mateo Co.; San Bruno Mts., ravine 0.5 air mile W. of 1314' summit, 500'; VI-11-72, one 1st instar larva on leaf upperside of *Angelica hendersonii* C. & R., *J. F. Emmel 406,* RSABG; reared to pupa on leaves of same; pupa died several months later. (Observation by J. F. Emmel only)

4. NEVADA: Elko Co.; Thomas Canyon Campground, Lamoille Canyon, Ruby Mts.; VIII-7-67, 2 larvae on leaf uppersides of *Angelica kingii* (Wats.) C. & R., *J. F. Emmel 31,* DHSU; reared to pupae on leaves of same; adults emerged in April, 1968.

5. NEVADA: Humboldt Co.; Martin Creek Ranger Station, 7000', Santa Rosa Range; VIII-11-67, 5 1st-3rd instar larvae taken on leaf uppersides of *Angelica kingii* (Wats.) C. & R., *J. F. Emmel 191,* UCB; reared to pupae on leaves of same; one adult emerged in April, 1968; the remaining pupae died.

6. CALIFORNIA: Inyo Co.; Whitney Portal, 8200', east slope Sierra Nevada; VII-27-74, 2 4th-5th instar larvae on leaf uppersides of *Angelica lineariloba* Gray, *J. F. Emmel 527,* RSABG; both died before pupating (observation by J. F. Emmel only). This large plant is common along the eastern slope of the Sierra Nevada, and is suspected to be a major foodplant of *P. zelicaon* in this area. Bruce Griffin (personal communication) and Lloyd Martin (personal communication) have also collected *zelicaon* larvae on this umbellifer.

7. CALIFORNIA: Riverside Co.; Bay Tree Flat Campground, 5250', northwest of Lake Fulmor, San Jacinto Mts.; VI-23-76, 1 ovum on leaf upperside of *Angelica tomentosa* Wats., *J. F. Emmel 550,* RSABG; reared to pupa on leaves of same; adult emerged VII-13-76 (observation by J. F. Emmel only). This plant is abundant in local colonies at 4000' to 6000' in the San Jacinto Mountains but appears to be used infrequently by *P. zelicaon.* Searches of this plant in several previous years have failed to yield immatures.

8. COLORADO: Gunnison Co.; near Brush Creek Cow Camp, along the East River below Gothic, 9000'; VIII-27-67, 6 4th-5th instar larvae taken on leaves of *Conioselinum scopulorum* (A. Gray) C. & R., *J. F. Emmel 43,* DHSU; 2 reared to pupae on leaves of same; adults emerged in November, 1968. This plant is found in small, scattered colonies in wet meadows along the East River. We spent 15 minutes searching a 5 m. X 10 m. area where this plant was locally common to find 6 larvae. Larvae were difficult to see due to the mottled shade cast over them by the finely dissected leaves; the low growth habit of this plant allows surrounding vegetation to partially shield it and give further protective cover to the larvae. The ease with which we located larvae on this plant suggests that it is a preferred foodplant in the Gothic area.

9. CALIFORNIA: Riverside Co.; Hemet, 0.9 air mile WNW of peak of Reservoir Butte, 1715'; immature stages taken on *Foeniculum vulgare* L. (plant specimen not pressed, determined by J. F. Emmel) on the following dates: X-14-76, 2 5th instar larvae on leaves; I-17-77, 1 4th instar and 2 5th instar larvae on leaves; II-15-77, 10 ova on leaves; V-5-77, 31 ova on leaves; X-17-77, 17 1st-3rd instar larvae on flowerbuds, flowers, and fruit. (All observations by J. F. Emmel only)

10. COLORADO: Gunnison Co.; along the East River, below Gothic, 9000'; VII-24-67, one 1st instar larva on leaf upperside of *Heracleum sphondylium* L. ssp. *montanum* (Schleich. ex Gaud.) Briq.; reared to pupa on leaves of same; adult emerged XII-10-68. Plant material was collected (but not pressed) and found to be identical with a specimen of *H. lanatum* Michx. in the RMBL herbarium, *L. Ore s.n.* Our plants also keyed out to *H. lanatum* in Harrington (1954). Current nomenclature now treats North American *H. lanatum* as *H. sphondylium.* Because it has large, relatively

flat leaves, this plant is easily searched for *Papilio* larvae. It is common along streams in the vicinity of Gothic, and we were able to search large numbers of plants for larvae. Despite this, we noted only the single instance of a *P. zelicaon* larva on it.

11. CALIFORNIA: San Mateo Co.; San Bruno Mts., meadow 0.7 air mile N. of 1314' summit; VII-25-70, 1 3rd instar larva on leaf of *Heracleum sphondylium* L. ssp. *montanum* (Schleich. ex Gaud.) Briq., *J. F. Emmel 324*, CAS; reared to pupa on leaves of same; died within several weeks of pupation. Additional immature stages were taken as follows: IX-6-71, 1 ovum, 7 1st-2nd instar larvae on leaf uppersides, reared to pupae on leaves of same; 2 adults emerged in October, 1971, the remainder going into diapause; IX-25-71, 14 1st-5th instar larvae on leaf uppersides, not reared; X-31-71, 1 3rd instar larva on leaf upperside, not reared. (All observations by J. F. Emmel only.) *H. sphondylium* appears to be used primarily during the late summer and fall months in this locality when *Foeniculum vulgare*, widespread in the area and probably the principle foodplant of *P. zelicaon* here, is starting to dry up and become less attractive to ovipositing females. Repeated searches of *H. sphondylium* in this locality during the spring months over a five-year period failed to reveal larvae.

12. NEVADA: Elko Co.; rocky slope near the Jarbidge River, 2 miles S. of Pine Creek Campground, Jarbidge Mts.; VIII-10-67, 2 larvae on leaves of *Ligusticum grayi* C. & R., *J. F. Emmel 34*, DHSU; reared to pupae on leaves of same; one adult emerged in February, 1969, the other pupa died.

13. COLORADO: Gunnison Co.; Gothic, 9600'; VII-18-67, female observed to oviposit on leaf upperside of *Ligusticum porteri* C. & R. Plant material was collected (but not pressed) and found to be identical with a specimen of *L. porteri* in the RMBL herbarium, *M. E. Mathias 3418*, collected at Gothic. Our plant also keyed out to *L. porteri* in Harrington (1954). This plant is common in the area around Gothic, preferring somewhat dry slopes; it sometimes forms a dominant ground cover. We searched numerous individuals of this species, failing to find any larvae.

14. CALIFORNIA: Napa Co.; hills N. of road above confluence of Pope Creek and Maxwell Creek; IV-7-68, 3 1st-2nd instar larvae on leaf uppersides of *Lomatium californicum* (Nutt.) M. & C., *J. F. Emmel 55*, UCB; reared to pupae on leaves of same; one pupa died in 1969, 2 adults emerged in April, 1970. In this locality, this plant begins to die back in May, and succulent leaves would be unavailable for a second generation of larvae of *P. zelicaon*.

15. CALIFORNIA: Napa Co.; hills N. of road above confluence of Pope Creek and Maxwell Creek; IV-7-68, 4 2nd-4th instar larvae on leaves of *Lomatium dasycarpum* (T. & G.) M. & C., *J. F. Emmel 56*, UCB; reared to pupae on leaves of same; all pupae went into diapause, but three died the following year; 1 adult emerged in April, 1970 (observation by J. F. Emmel only). This *Lomatium* dies back sooner than does *L. californicum;* in fact, on the plants which produced larvae, some leaves were already turning brown on this date.

16. NEVADA: Lander Co.; lower end of Birch Creek Canyon, 6300', Toiyabe Range; VI-13-69, 8 4th-5th instar larvae on leaves of *Lomatium dissectum* (Nutt.) M. & C. var. *multifidum* (Nutt.) M. & C., *J. F. Emmel 160*, UCB; reared to pupae on leaves of same; all went into diapause; 1 adult emerged in February, 1970, and 1 adult emerged in February, 1971; the remaining pupae died during 1971-1972.

17. CALIFORNIA: Napa Co.; ridge 0.4 air mile NNW of Jct. of Butts Cyn. Road and Snell Valley Road, 800-1000'; IV-19-70, 12 ova and 1st-3rd instar larvae on leaves of *Lomatium marginatum* (Benth.) C. & R., *J. F. Emmel 265*, UCB; 3 reared to pupae on leaves of same, and all went into diapause; 1 adult emerged in May, 1971; the remaining pupae died in 1972. The leaves of this plant begin to die back in May, but it remains

green somewhat longer than does *L. californicum, L. dasycarpum,* and *L. utriculatum.* It seems doubtful that a second brood of *zelicaon* could utilize it.

18. NEVADA: Nye Co.; Troy Canyon, 7000', west slope of Grant Range; VII-7-69, 3 3rd-5th instar larvae taken on leaves of *Lomatium parryi* (Wats.) Macbr., *J. F. Emmel 182,* UCB; reared to pupae on leaves of same; 1 adult emerged in February, 1970; the remaining pupae died during 1970. This is an unusual foodplant for *P. zelicaon,* as it grows in a decidedly more xeric habitat than that in which *zelicaon* is usually found. We suspect that the primary foodplants of *zelicaon* in the Grant Range occur at slightly higher, moister elevations where more apiaceous species grow, and that *L. parryi* is used infrequently.

19. CALIFORNIA: Napa Co.; Table Rock, 2400', SE of Mt. St. Helena; IV-14-68, 6 ova on leaf undersides of *Lomatium utriculatum* (Nutt.) C. & R., *J. F. Emmel 58,* UCB; 3 reared to pupae on leaves of same; all pupae went into diapause; 1 adult emerged in April, 1969; remaining pupae died in 1970. The leaves of this plant die back during May and early June, preventing utilization by a second brood of *P. zelicaon.*

20. CALIFORNIA: Mariposa Co.; rocky slope above Skelton Creek, 2800-3000', near Jerseydale; III-29-70, female observed to oviposit at 12:48 p.m. PST on leaf underside of *Lomatium utriculatum* (Nutt.) C. & R., *J. F. Emmel 240,* UCB; ovum not reared.

21. CALIFORNIA: San Mateo Co.; San Bruno Mts., meadow 0.7 air mile N. of 1314' summit; VII-25-70, female observed to oviposit at 11:36 a.m. PST on leaf underside of *Oenanthe sarmentosa* Presl., *J. F. Emmel 323,* CAS. Additional observations: IX-6-71, female observed to oviposit at 11:38 a.m. PST on leaf underside; IX-25-71, 8 1st-3rd instar larvae on leaf uppersides, reared to pupae on leaves of same; 2 adults emerged X-30-31-71, remaining pupae went into diapause but died during 1972-1973; X-31-71, 1 5th instar larva on leaf upperside, reared to pupa, but died a few days later. (All observations by J. F. Emmel only.) Like *Heracleum sphondylium* in this locality, *O. sarmentosa* seems to be used by *P. zelicaon* primarily during the summer and fall months, when fewer "suitable" plants of the commonly used *Foeniculum vulgare* are available to ovipositing females.

22. COLORADO: Gunnison Co.; Crested Butte cemetery, 8900'; VI-22-67, female observed to oviposit on leaf upperside of *Pseudocymopterus montanus* (Gray) C. & R. Plant material was collected (but not pressed) and found to be identical to a specimen of *P. montanus* in the RMBL herbarium, *M. E. Mathias 3419,* collected at Gothic. Our plant also keyed out to *P. montanus* in Harrington (1954). *Pseudocymopterus* grows in dry meadows and on forested and open slopes, and seems relatively common around Gothic. We repeatedly searched plants of this species over a two-month period, but failed to locate any immature stages on it.

23. COLORADO: Montrose Co.; Warner Point, South Rim, Black Canyon of the Gunnison National Monument, 8000-8300'; VII-5-67, 2 2nd-3rd instar larvae on leaves of *Pteryxia hendersoni* (C. & R.) M. & C., *T. C. Emmel 17,* RSABG (plant material had been previously collected in this locality by T. C. Emmel in 1964); reared to pupae on leaves of same; adults emerged in March, 1968; VII-23-67, 1 1st instar larva on leaf upperside, reared to 4th instar and died.

24. NEVADA: Lander Co.; Kingston Canyon, 6600', Toiyabe Range; VI-13-69, 5 3rd-5th instar larvae taken on leaves of *Pteryxia petraea* (Jones) C. & R., *J. F. Emmel 154,* UCB; reared to pupae on leaves of same; all pupae went into diapause but died the following year.

25. CALIFORNIA: Mono Co.; slope 0.4 air mile S. of Slinkard Creek, 6000-6400', S. of Topaz Lake; VI-19-70, 3 4th-5th instar larvae taken on leaves of *Pteryxia terebinthina* (Hook.) C. & R. var. *californica* (C. & R.)

Math., *J. F. Emmel 321,* UCB; reared to pupae on leaves of same; pupae went into diapause, but died the following year. This is probably one of the major foodplants of *P. zelicaon* in the higher elevations of the Sierra Nevada. It has been established as a foodplant for this species at Donner Pass, Placer Co. (Emmel & Emmel, 1974), and at Kaiser Peak, Fresno Co. (Lloyd Martin, personal communication).

26. CALIFORNIA: Inyo Co.; Ruby Lake, 11,200', near Inyo-Fresno Co. line; VIII-4-68, 1 4th instar larva taken on leaf upperside of *Sphenosciadium capitellatum* A. Gray, *J. F. Emmel 107,* UCB; reared to pupa on leaves of same; adult emerged in April, 1969.

27. CALIFORNIA: Inyo Co.; Independence Creek, 4550', Owens Valley, WSW of Independence; VI-20-77, 2 5th instar larvae on leaf uppersides of *Sphenosciadium capitellatum* A. Gray, *J. F. Emmel 566,* RSABG; reared to pupae on leaves of same; 1 adult emerged VII-6-77, the other remained in diapause. (Observation by J. F. Emmel and T. C. Emmel). This plant retains green leaves well into August, and could serve as a host for a second brood of larvae.

28. CALIFORNIA: Riverside Co.; along Double View Drive, SW of Idyllwild, 5300', San Jacinto Mts.; VI-25-69, 2 3rd-4th instar larvae on leaf uppersides of *Tauschia arguta* (Nutt.) C. & R., *J. F. Emmel 171,* UCB; reared to pupae on leaves of same; one adult emerged VII-21-69; the other pupa went into diapause but subsequently died. One of us (JFE) has frequently collected *P. zelicaon* larvae on this umbellifer in the southern California mountains; it appears to be one of the major native hosts in this area. Some plants at higher elevations retain green leaves as late as August, and could support second brood larvae.

29. CALIFORNIA: San Bernardino Co.; near Sheep Creek wash, NE of Wrightwood, 5100', San Gabriel Mts.; VI-3-73, 2 4th-5th instar larvae taken on leaf uppersides of *Tauschia parishii* (C. & R.) Macbr., *J. F. Emmel 463,* RSABG; reared to pupae on leaves of same; adults emerged in the spring of 1974; VI-9-74, 4 ova on leaf uppersides; 2 reared to pupae; 2 adults emerged VII-6-74. (Both observations by J. F. Emmel and Bruce Griffin.) Many individuals of this *Tauschia* remain green and succulent well into late August, and are able to support a summer brood of *P. zelicaon.* James Haney (personal communication) has found *zelicaon* larvae on this plant along the eastern base of the Sierra Nevada, where it probably serves as a major foodplant.

30. CALIFORNIA: San Bernardino Co.; Redlands, at San Bernardino County Museum; VIII-10-77, 2 ova on new growth of Navel Orange, *Citrus sinensis* (L.) Osbeck (plant specimen not collected; determination by J. F. Emmel) (RUTACEAE); reared to pupae on leaves of same; adults emerged in August, 1977. (Observation by J. F. Emmel only).

31. CALIFORNIA: Riverside Co.; Hemet, 0.9 air mile WNW of peak of Reservoir Butte, 1715'; X-14-76, 1 5th instar larva on leaf upperside of new growth of Meyer Lemon, *Citrus limon* (L.) Burm. (plant specimen not collected; determination by J. F. Emmel) (RUTACEAE); reared to pupa on leaves of same; adult emerged in November, 1976; VIII-6-77, 6 ova on new leaves, reared to pupae on same; adults emerged in September, 1977; XI-10-77, 3 1st-instar larvae on uppersides of new leaves; reared to pupae in sleeve over leaves of same in garden, pupation occurring in mid-December; pupae went into diapause. One of us (JFE) has observed *P. zelicaon* adults flying in the *Citrus* groves around Hemet in every month from February to November, indicating that this *Citrus*-feeding population is multiple-brooded.

TABLE 1. FOODPLANTS OF *PAPILIO ZELICAON*

O = OVIPOSITION BY FEMALE ON PLANT OR OVA FOUND ON PLANT

L = LARVAE FOUND ON PLANT

FOODPLANT	LOCALITY	OBSERVATION
APIACEAE		
Angelica ampla A. Nels.	vic. Gothic, Gunnison Co., Colo.	L
Angelica arguta Nutt. ex T. & G.	Trinity Alps, Siskiyou Co., Calif.	L
Angelica hendersonii C. & R.	San Bruno Mts., San Mateo Co., Calif.	L
Angelica kingii (Wats.) C. & R.	Ruby Mts., Elko Co., Nevada	L
	Santa Rosa Range, Humboldt Co., Nevada	L
Angelica lineariloba Gray	Sierra Nevada, Inyo Co., Calif.	L
Angelica tomentosa Wats.	San Jacinto Mts., Riverside Co., Calif.	O
Conioselinum scopulorum (A. Gray) C. & R.	vic. Gothic, Gunnison Co., Colo.	L
Foeniculum vulgare L.	Hemet, Riverside Co., Calif.	O, L
Heracleum sphondylium L.	vic. Gothic, Gunnison Co., Colo.	L
ssp. *montanum* (Schl. ex Gaud.) Briq.	San Bruno Mts., San Mateo Co., Calif.	L
Ligusticum grayi C. & R.	Jarbidge Mts., Elko Co., Nevada	L
Ligusticum porteri C. & R.	vic. Gothic, Gunnison Co., Colo.	O
Lomatium californicum (Nutt.) M. & C.	Pope Creek, Napa Co., Calif.	L
Lomatium dasycarpum (T. & G.) M. & C.	Pope Creek, Napa Co., Calif.	L
Lomatium dissectum (Nutt.) M. & C.	Toiyabe Range, Lander Co., Nevada	L
var. *multifidum* (Nutt.) M. & C.		

Lomatium marginatum (Benth.) C. & R.	Butts Cyn., Napa Co., Calif.	O, L
Lomatium parryi (Wats.) Macbr.	Grant Range, Nye Co., Nevada	L
Lomatium utriculatum (Nutt.) C. & R.	Table Rock, Napa Co., Calif.	O
	Jerseydale, Mariposa Co., Calif.	O
Oenanthe sarmentosa Presl.	San Bruno Mts., San Mateo Co., Calif.	O, L
Pseudocymopterus montanus (Gray) C. & R.	vic. Gothic, Gunnison Co., Colo.	O
Pteryxia hendersoni (C. & R.) M. & C.	Black Canyon of the Gunnison, Montrose Co., Colo.	L
Pteryxia petraea (Jones) C. & R.	Toiyabe Range, Lander Co., Nevada	L
Pteryxia terebinthina (Hook.) C. & R. var. *californica* (C. & R.) Math.	Sierra Nevada, Mono Co., Calif.	L
Sphenosciadium capitellatum A. Gray	Sierra Nevada, Inyo Co., Calif.	L
	Owens Valley, Inyo Co., Calif.	L
Tauschia arguta (Nutt.) C. & R.	San Jacinto Mts., Riverside Co., Calif.	L
Tauschia parishii (C. & R.) Macbr.	San Gabriel Mts., S. Bernardino Co., Calif.	O, L
RUTACEAE		
Citrus sinensis (L.) Osbeck	Redlands, San Bernardino Co., Calif.	O
Citrus limon (L.) Burm.	Hemet, Riverside Co., Calif.	O, L